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TECHNICAL NOTE

ENERGY CONSERVATION IN GREENHOUSES V. A THERMAL CURTAIN PERFORMANCE UPDATE

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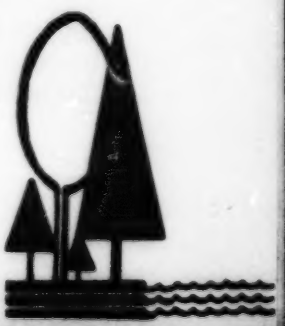
INTRODUCTION

Created in response to the rising costs of energy, thermal curtain technology has continued to develop and its use is becoming increasingly widespread. Depending on the type of fabric used in the curtain, the same system may have an additional use for both shading and/or photoperiodic control. A wide variety of such systems are now available commercially and nurserymen may choose systems tailored to perform according to the specific needs of a particular cultural regime.

Although information has been available for some time on the use of various materials and systems (Cameron 1979), as yet there is little information available on the actual operational energy savings of high and low R-value curtain systems which might have winter use in a container nursery. This note is intended to provide an update on thermal curtain performance, using the results of an operational tests at Kingsclear PFN. A practical, general method is also presented, whereby a greenhouse operator can monitor the thermal performance of almost any newly-implemented energy conservation measure.

SIMPLE HEAT USE MEASUREMENT METHODS

It is easy to monitor curtain performance accurately. A unit heater fan must turn on whenever a greenhouse with underbench polytube heating requires heat. Therefore, by attaching a simple sensing device, such as a relay, to be activated by the same circuit that supplies power to the unit heater, it is possible to measure the number of minutes of unit heater "on-time" on an hourly or nightly basis using some standard timing device attached to the relay.



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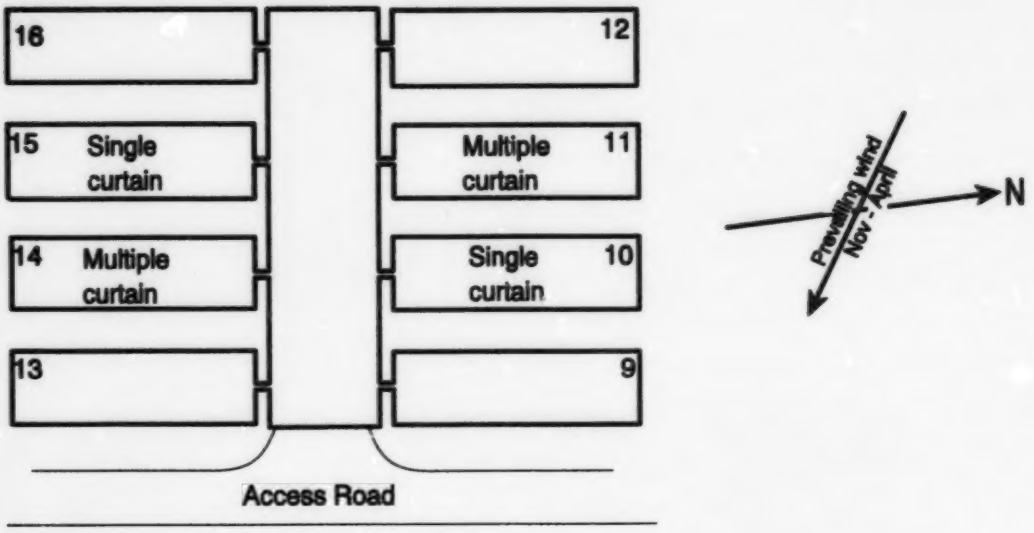

Figure 1. Layout of Kingsclear greenhouse complex no. 2 showing prevailing winter wind direction. Greenhouse numbers correspond to the ones shown in figure 2.

Performance over a number of days or weeks can then be monitored. Adjacent greenhouses, with and without curtains, can be compared on the same nights, or the same greenhouse can be compared to itself by deploying the curtain only every second night.

The operational study performed at Kingsclear PFN was done during January and February 1984 (during the period of peak heat demand), using the eight greenhouses of Complex Two. Two different types of thermal curtain were tested: a single-layer curtain (Growers Technical Services, Mississauga, Ont.) with a nominal R-value of 1-2 was compared to a three-layer system (Roll-Out Systems Ltd., Lancaster, N.Y., U.S.A.) with a suggested R-value of 5-6. Each curtain type was installed in two greenhouses and the curtains were deployed every second night for two months. Unit heater on-times were recorded to the nearest 0,5 min. by wiring in A.C. adapters (of the kind commonly used by power calculators or tape recorders) which provided a small D.C. voltage to an event recorder. Between dusk and dawn, hourly totals of unit heater on-time were recorded, along with average hourly temperatures both indoors and outside. The greenhouse complex layout and prevailing wind are shown in Figure 1.

Although an event recorder was used for this study, it is important to note that when there is a greenhouse computer present on site, the datalogging can all be done automatically, since the computer already controls heating and records temperatures and light levels (day/night). Periodic reports of heating performance can be routinely generated using an optional software program which can be written by the computer supplier at moderate cost, if it is not already included with the system.

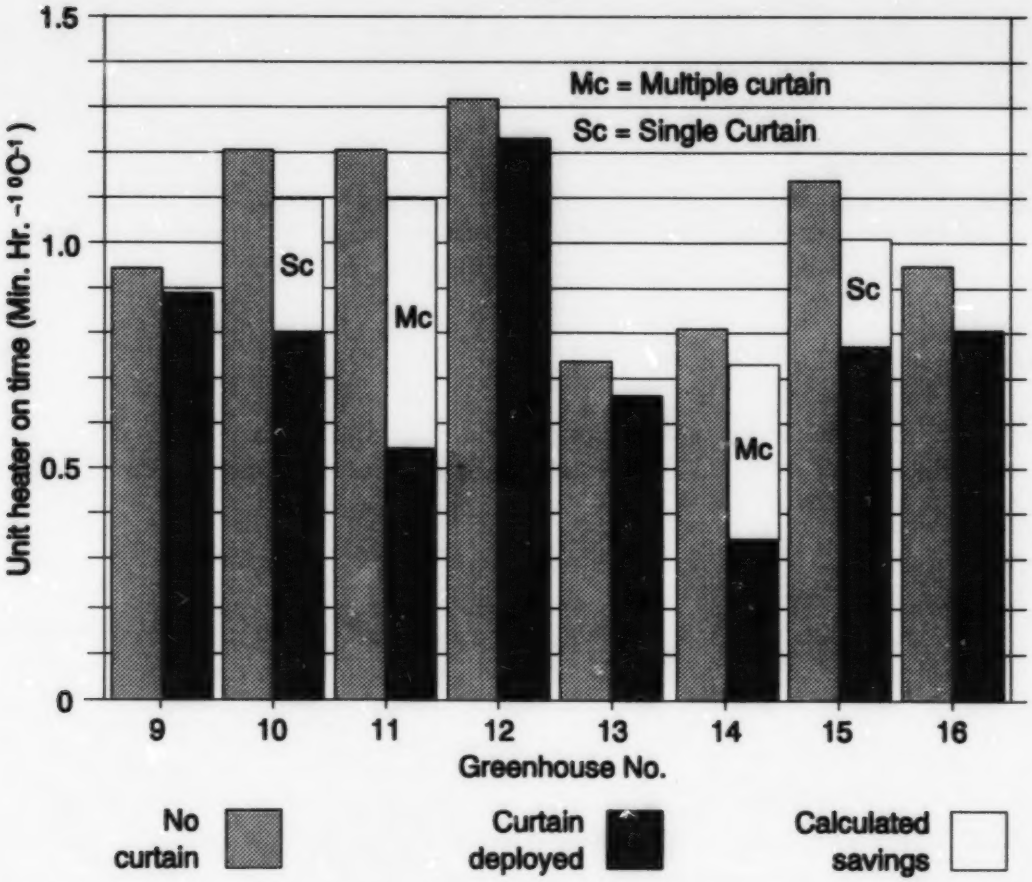

Figure 2. Greenhouse energy use in Kingsclear complex no. 2 on alternate nights when thermal curtains were or were not deployed (in greenhouses 10, 11, 14 and 15 only). Areas labelled "Mc" or "Sc" are the amount of energy calculated to have been saved by using the curtains.

KINSCLEAR STUDY RESULTS

Figure 2 shows that the multiple-layer curtain gave heat savings of approximately 45 - 50% each night it was deployed, and the single layer curtain saved approximately 20 - 25% nightly. Since 75 - 80% of greenhouse heat loss occurs at night, annual fuel consumption would be reduced by about (0.5 x 0.8) = 40% or (0.25 x 0.8) = 20% for the multiple curtain or single curtain, respectively.

Use of energy curtains follows what is fast becoming a rule-of-thumb in the greenhouse industry: divide the R-value specified by the manufacturer for the fabric by two in order to calculate fuel savings (Anon. 1986). Since the other components of energy loss have been calculated for Kingsclear PFN (Cameron 1982), the operational R-value of the two curtains can be calculated as approximately R-0.8 to 1 and R-3, respectively, for the single and multiple-layer curtains. The lower values probably reflect cold air leakage around the perimeter of both types of curtain, due to imperfect sealing.

Finally, the sensitivity of even a fairly crude energy monitoring method can be seen by inspecting the thermal performance of all of the greenhouses generally. The more exposed the greenhouses are to the prevailing wind, the more heat they lose, in either a north versus south side or a within side ((especially among the northern side greenhouses) comparison. Deviation from normal or expected patterns of heat use is also detectable. For example, greenhouse no. 15 shows higher energy consumption than might otherwise be expected. This sort of result may be useful in checking for leakage around a vent cover or for indicating when a unit heater power relay is sticking in the "on" position.

SUMMARY

Although their R-values are comparatively low, both curtain types would save enough energy to justify the capital investment. The value of a simple energy monitoring system for routine nursery use is also obvious.

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